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Development of a  
**Closed-Loop/Water Reuse  
System for a Large Wire  
Extrusion Facility**

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# Project Background

- 1M square foot wire facility
- Extrudes plastic and rubber compounds over single strand and woven copper wires
- Diverse, dynamic product mix
- Long standing ties to adjacent river
  - *Non-contact and contact cooling water*
- Facility feed water from river
- NPDES discharge to river



# Project Background

- 700K to 1M GPD river withdrawal
  - *800K GPD average*
- Once-through contact/non-contact cooling
- Contact cooling for extrusion baths
- Non-contact cooling for extrusion and other machinery
- Under-serviced bath areas

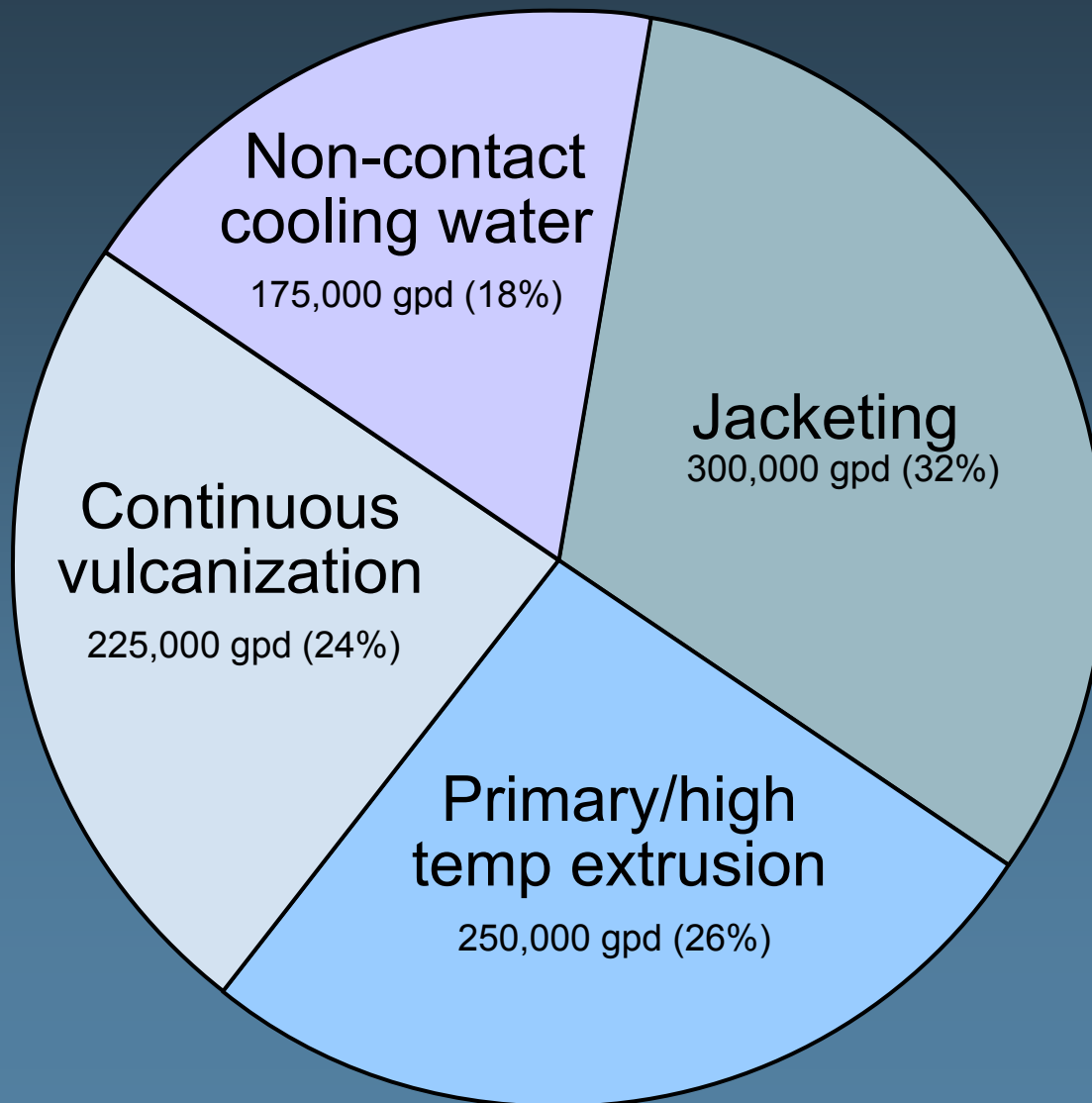


# Project Background

- Hot and cold water baths
- No attempts for heat recapture
- Mixing of all cooling water prior to discharge
- Cold water baths required use of chillers (ongoing)
- Hot water baths required dedicated boiler



# Water Use by Process





# Permit Requirements

- Requirement to reduce water use
  - *Order imbedded in NPDES permit*
- Order steps
  - *Study*
  - *Design/regulatory approval*
  - *Construction/regulatory approval*
  - *Start-up and operation*
- Stringent water quality based and categorical limitations for metals, BOD and TSS



# Project Study/Concept Design

- NPDES permit limits likely unattainable without advanced treatment.
  - *Some leaching from extrusion materials*
  - *Treatment technologies / interferences*
  - *Complicated by river water quality (BOD/TSS)*
- Simplistic decision process to develop system closed loop/water reuse system



# Project Study/Concept Design

- Decision made to sever tie with adjacent receiving stream
  - *Projected reduction in regulatory liabilities*
- Switch to high quality municipal feed and low-volume sewer discharge - 'blowdown'
- Heat recovery for hot water baths
- Water reuse/recycle to rinsewater quality 'limit' – product driven





# Project Concerns

- Overwhelming concern on quality of re-circulating rinse.
- Material leaching, microbiological growth and metals dissolution could cause problematic rinse quality issues.
- Numerous steps built into design and construction to minimize potential for rinsewater quality degradation.



# System Design

- Incoming feed water TDS – 25 to 50 mg/L
- Level of recirculation / reuse to be determined in practice - dynamically
- TDS balance maintained through cooling tower drift, system 'blowdown' and filter backwash
- Organic materials leaching concerns



# System Design – Bacterial Growth Reduction Measures

- Chlorinated municipal feed
- Algaecide/corrosion inhibitor in process
- Multi-media filtration and system backwash to sanitary sewer



# Side Stream Filter







# Conductivity/pH Meter





# System Design – Transfer Piping

- No iron or copper piping used in process
- Schedule 5 stainless steel used in almost all transfer piping
- Some PVC used in drain piping
- Abandonment of miles of existing piping
- Lined concrete recirculation sumps

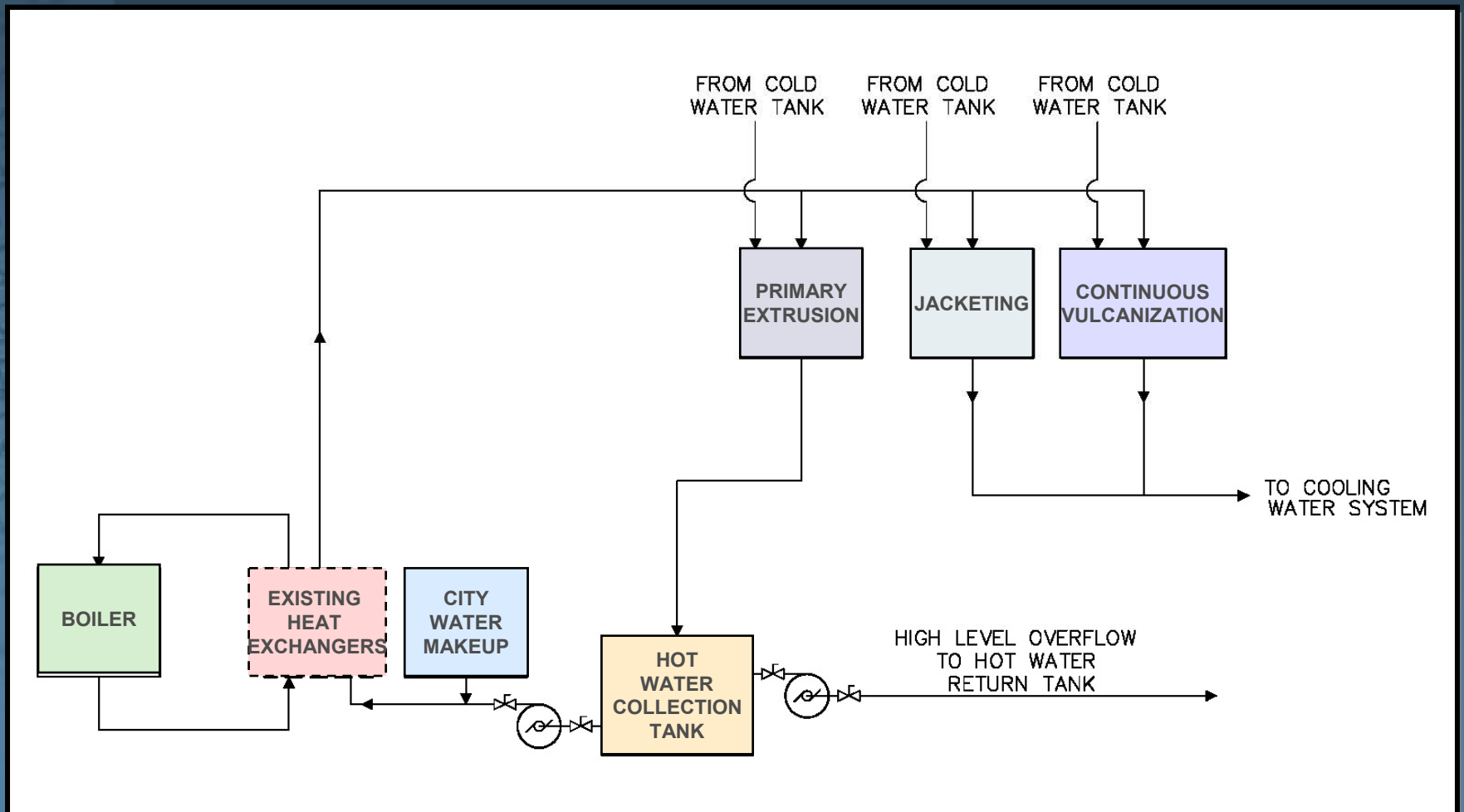


# System Design – Heat Recovery

- Hot water baths used for certain extrusion processes to avoid material cracking
- Majority of hot water use in one process
- Hot water extrusion baths captured, pumped through heat exchanger prior to re-entry to recirculation system
- Few months payback on heat recovery system



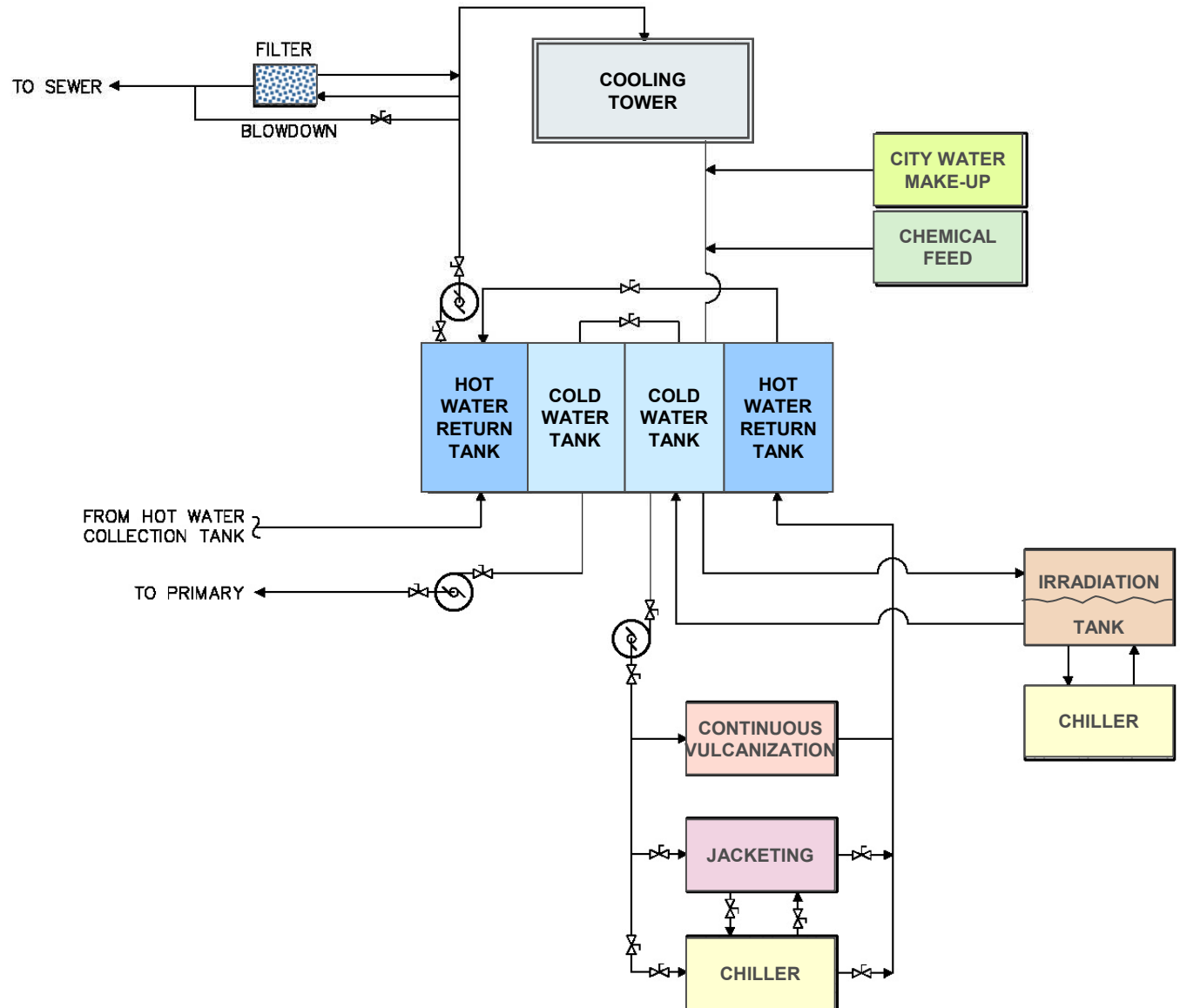
# Heat Recovery Schematic







# Closed Loop System Cold Water Schematic





# System Construction

- Construction on major items non-problematic
- Numerous field challenges
- History of water tap tie-ins with no records
- Need to *completely* eliminate contact/non-contact cooling water discharge
- Elimination of NPDES discharge not a goal, but a requirement



# System Construction

- \$1.5M construction cost
- Design-build approach
- Numerous field decisions due to historic, undocumented pipe chases
- 6 month construction window
- \$90,000 received in energy credits (VFDs on cooling tower, transfer pumps)



# Transfer Pumps







# High Pressure Pumps





# Cooling Tower





# System Operation

- Intake water
  - *800K gpd river water intake reduced to 40K gpd municipal feed*
- System discharge
  - *800K gpd NPDES process wastewater discharge reduced to 4K gpd system blowdown to sanitary sewer*
  - *No pretreatment standard for rubber categories to sewer for BOD/TSS*
  - *Monitoring reduced by 95 percent*





# System Operation

- Cooling bath 'vigor' maintained or increased
- Production increase with upgrade of under-serviced baths areas
- 800K (+) gpd cooling – 40K gpd makeup
- 20 cycles of reuse/recirculation
  - *35K gpd evaporation*
  - *4K gpd system blowdown, 1K gpd filter backwash*





# System Operation

- 95% reduction in feed flows
  - *Cost savings balancing abandonment of large supply system and tankage with purchase of municipal feed*
- 99.5% reduction in discharge
  - *Commensurate reduction in wastewater monitoring and fees*



# System Operation

- 30 mmbtus recovered daily (\$200 in fuel per day), which offset new system energy needs (e.g., cooling tower)
- Sizable maintenance reduction
  - *Elimination of supply-side system*
  - *Upgrade of key, 'problematic' sites in system*
- ROI not calculated, but significant reduction in environmental liability